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ABSTRACT

It has been 25 years since the publication of J. B. Carroll's (1963) seminal work on the model of school learning (MSL) and its subsequent identification by B. S. Bloom (1968) as the theoretical basis underlying mastery learning. Carroll's model of school learning is a theoretical formulation asserting that the degree of learning attained on a given task is a function of the time spent by a student on the task divided by the time needed by the student for the mastery of that task. Bloom's mastery learning theory encompasses: (1) a set of optimistic assumptions regarding the capability of students to learn the contents of a course/unit to a high degree of proficiency provided that learning conditions are maximized; and (2) an array of instruction-based functions or purposes served by the preparatory, delivery, and evaluative tasks of diagnostic-prescriptive teaching. This paper provides a 25-year retrospective view of the foundational role assumed by the variables and operations of Carroll's MSL in directing mastery learning efforts. More specifically, attention is given to the strategic impact of Carroll's conceptualizations of aptitude, quality of instruction, and opportunity to learn on Bloom's optimism regarding the capability of students to learn and his diagnostic-prescriptive teaching regimen. (Author/SLD)

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The Carroll Model of School Learning: A 25-Year Retrospective View of Its Foundational Role in Mastery Learning Theory and Practice

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Abstract

It has been 25 years since the publication of Carroll's (1963) seminal work on the model of school learning (MSL) and its subsequent identification by Bloom (1968) as the theoretical basis underlying mastery learning. This paper provides a retrospective view of the foundational role assumed by the variables and operations of Carroll's MSL in directing mastery learning efforts. More specifically, attention is given to the strategic impact of Carroll's conceptualizations of aptitude, quality of instruction, and opportunity to learn on Bloom's optimism regarding the capability of students to learn and his diagnostic-prescriptive teaching regimen.

The Carroll Model of School Learning: A 25-Year Retrospective View of Its Foundational Role in Mastery Learning Theory and Practice

Carroll's (1963) model of school learning is a theoretical formulation asserting that the degree of learning attained on a given task is a function of the time spent by a student on the task divided by the time needed by the student for the mastery of that task. Accordingly, the model is formulated as follows:

$$\text{Degree of Learning} = f\left(\frac{\text{Time Spent}}{\text{Time Needed}}\right)$$

Additionally, Carroll's model suggests that a student's time needed to learn a given task is determined by such factors as the student's aptitude and ability to understand instruction as well as the quality of instruction to which the student is exposed. Regarding the numerator in the model, time spent, Carroll identifies such factors as student perseverance and opportunity to learn as the principal determining variables.

Bloom's (1968) mastery learning has been characterized repeatedly in the literature as encompassing (a) a set of optimistic assumptions regarding the capability of students to learn the contents of a course/unit to a high degree of proficiency provided that learning conditions are maximized and (b) an array of instruction-based functions or purposes served by the preparatory, delivery, and evaluative tasks of diagnostic-prescriptive teaching (see, e.g.: Anderson & Jones, 1981; Block, 1980; Block & Anderson, 1975; Block & Burns, 1976;

Block, Efthim, & Burns, 1988; Bloom, 1968, 1976, 1978, 1980; Guskey, 1985; Hymel, 1981).

This current year of 1988, obviously, represents a quarter-of-a-century since the publication of Carroll's seminal work on the model of school learning (MSL) and the twentieth year since its original identification by Bloom (1968) as the theoretical basis underlying mastery learning (ML). The intent of this paper, then, is to provide a 25-year retrospective view of the foundational role played by the variables and operations of Carroll's model in directing mastery learning efforts. More directly--following an overview of the model and mastery learning--I will attempt to highlight the strategic impact of Carroll's conceptualizations of aptitude, quality of instruction, and opportunity to learn on Bloom's optimism regarding student learning capability and his diagnostic-prescriptive teaching regimen.

Components & Operations of Carroll's MSL

As already alluded to, the five factors or variables which comprise the Carroll model include the following: aptitude, ability to understand instruction, quality of instruction, opportunity, and perseverance. While aptitude, ability to understand instruction, and quality of instruction function as determinants of time needed, opportunity and perseverance serve as determinants of time spent. Each of these five components, as well as the manner in which they operate to determine the denominator (time needed) and the numerator (time spent) of the model, has been defined and explicated by Carroll (1963, 1965, 1970, 1985) in the following manner:

Aptitude. As one of the three determinants of time needed for learning, aptitude pertains to the amount of time required by a student to master a given task under optimal instructional conditions. The optimal conditions of instruction referred to include the following: (a) the implementation of those teaching techniques deemed most appropriate for a given student's own learning needs, (b) the provision of an ample amount of time during which the student could master the task, and (c) a willingness on the part of the student to spend the necessary time required to attain mastery. As viewed from the perspective of the model, aptitude refers to potential learning rate rather than potential level or complexity of learning and, hence, differs from the conventional psychometric connotations associated with the expression.

Ability to understand instruction. Proposed as a variable independent of aptitude, but contributing to the determination of time needed nonetheless, ability to understand instruction refers to the ability of a student to perceive and to understand (a) the nature of the learning task with which one is confronted and (b) the procedures one must follow in order to master the task. This component of the model can be thought of as the generalized ability of a student to benefit from the explanations of teachers and instructional materials. Due to the generalized nature of this variable as well as the highly verbal orientation of our schools, appropriate indices of ability to understand instruction include measures of general intelligence, verbal ability, reading comprehension, listening skills, or some combination thereof.

Quality of instruction. The third determinant of time needed, quality of instruction, is defined as the extent to which the various elements of a learning task are organized, presented, and explained in a manner commensurate with the special needs and characteristics of the learner. In elaborating on this variable, Carroll (1970) has asserted that the following three elements are of particular importance in the endeavor to provide a high quality of instruction: (a) the specification of objectives for the purpose of identifying exactly what the learning task is, (b) the appropriate sequencing of learning subtasks, and (c) the employment of formative or diagnostic tests along with the accompanying prescription of alternative resources for remedial and/or enrichment activities.

Carroll's hypothesized interaction between ability to understand instruction and quality of instruction. Two of the determinants of time needed for learning, ability to understand instruction and quality of instruction, are hypothesized to interact in such a way that students low in ability to understand instruction will suffer more with respect to degree of learning when subjected to low quality of instruction than will students high in ability to understand instruction. It is reasoned that

> learners with high ability . . . will be able to figure out for themselves what the learning task is and how they can go about learning it; they will be able to overcome the difficulties presented by poor quality of instruction by perceiving concepts and relationships in the teaching

> materials which will not be grasped by those with lesser ability. (Carroll, 1963, p. 727)

Determining time needed for learning. In those situations where quality of instruction is less than optimal for a given learner, additional time will be needed beyond that already required by virtue of one's aptitude for the particular task being confronted. Furthermore, the amount of extra time required will be inversely related to the student's ability to understand instruction.

Thus, the actual time needed by a student for the mastery of a given learning task can be expressed as a function of one's aptitude (amount of time required for learning under optimal instructional conditions) plus the interaction between ability to understand instruction and quality of instruction (additional time needed for learning as determined by the student's level of ability to understand instruction and the extent to which the quality of instruction deviates from that which is optimal for the learner).

Opportunity. Opportunity, the first of two principal determinants of time spent, refers to the total amount of time allowed or made available for learning. The allotment of a given amount of time for learning which is less than either the time needed by the student or the time one is willing to spend serves to reduce the degree of learning and, thus, results in incomplete learning. This type of situation which involves inadequate time allotments is especially detrimental to the

student who is confronted with a poor quality of instruction and/or possesses a low ability to understand instruction.

Perseverance. As the second factor of the model which determines time spent in learning, perseverance is defined as the amount of time a student is willing to spend actively engaged in a learning task. In those instances where the perseverance of a student is restricted due to insufficient time allotments (opportunity) or is less than the time needed by the student, the degree of learning that results is less than optimal. Though not explicitly stated in the model, it can be inferred logically that ability to understand instruction and quality of instruction do exert an interactive effect on perseverance in a manner similar to their hypothesized interactive effect on degree of learning.

Determining time spent in learning. The time actually spent in learning by a student is viewed as being equal to the smallest of the following three factors: (a) opportunity, (b) perseverance, and (c) time needed. Concerning the rationale behind the use of time needed as a potential determiner of time spent, a basic assumption in the model is that a student will never spend more time than actually needed to master a given task. Hence, when the time allowed (opportunity) for learning permits the student to persevere to mastery, time spent is then equal to time needed.

Theoretical Assumptions & Functional Dimensions of Bloom's Mastery Learning

General optimistic assumptions. Regarding the optimistic theoretical assumptions of mastery learning, Bloom (1968, 1971, 1976, 1978, 1980) and his colleagues (most notably, Block, 1980, 1985) have challenged the social Darwinian mind set and selective function of education so prevalent in American schooling by arguing that under favorable learning conditions the following expectations are indeed viable: (a) most students, perhaps 90-95%, can master what we have to teach them; (b) as many as 80% of our students can attain those high levels of achievement typically reached by only the top 20%; and (c) most students become very similar--rather than dissimilar--with respect to learning ability, rate of learning, and motivation for further learning.

Optimistic assumptions regarding individual differences among students. Developed most extensively in his book Human Characteristics and School Learning, Bloom (1976) has distinguished between (a) individual differences in learners and (b) individual differences in learning in the following way: Differences in learners are certainly not denied, are recognized in the context of the learner's history, are assessed to account for 65% of the variance in school achievement, and are most globally characterized as encompassing the student's cognitive entry behavior and affective entry characteristics. The differences in learning are a common observation, are typically shown to increase substantially as

students progress up the educational ladder, and are most comprehensively viewed as including level/type of achievement, rate of learning, and affective outcomes.

Unfortunately, though, "individual differences in learners are invoked to explain and account for individual differences in learning and as a rationalization for the differential opportunities for further learning to be provided by the schools and the communities that support them" (Bloom, 1976, p. 8). In response to this regrettable situation, Bloom goes on to note the following:

> In spite of all the evidence on the existence and stability of differences in school learning, this writer is convinced that much of the variation is attributable to the environmental conditions in both the home and the school. Much of individual differences in school learning may be regarded as man-made and accidental rather than fixed in the individual at the time of conception. (p. 9)

Essentially, then, Bloom's contention is that the typically wide range of individual differences in school learning is more an environmental/instructional artifact born of less than optimal conditions for learning than it is a naturally occurring phenomenon that is inevitable. The optimism here should be as obvious as the responsibility placed on the shoulders of educators whose task it is to design curricular and instructional programs that indeed serve as effective intervention strategies.

Functional dimensions of mastery learning. Regarding the instruction-based functions or purposes of mastery learning, the principal emphasis here is that of adaptive or diagnostic-prescriptive teaching along with criterion-referenced evaluation, accomplished within the overall context of the following instructional specifications: (a) preconditions, that is, engaging in appropriate pre-service and in-service teacher development efforts so as to ensure teacher adoption of a mastery learning perspective, formulating for each instructional unit of each course a specification of what is meant by subject mastery, organizing each course into a sequence of manageably-sized instructional units, and developing feedback-correction/enrichment procedures for each unit; and (b) operating procedures, that is, orienting the students to mastery learning principles and procedures, teaching each unit via the usual group-based or individually-based methods, administering the intermittent formative tests within each unit, prescribing the learning correctives/enrichments as needed and/or certifying appropriate student progress within each unit, and administering the end-of-unit summative test for each instructional sequence (see, specifically: Anderson & Jones, 1981; Block, 1971, 1980; Block & Anderson, 1975; Block & Burns, 1976; Block et al, 1988; Bloom, 1968, 1971, 1976, 1978, 1980; Guskey, 1985; Hymel, 1981, 1984). Accordingly,

> if humans are born equal or can become equal with regard to learning, then the home and the school have responsibilities far greater than they have assumed

> in the past. If equality of learning is possible, then the selective function of schools must be largely abandoned in favor of the developmental functions which schools must increasingly serve. (Bloom, 1976, pp. 208-209)

Aptitude, Quality of Instruction, & Opportunity To Learn: Their Strategic Ramifications for Mastery Learning

Granted the advantages that accrue to hindsight over the span of 25 years, it appears to me that Carroll's inclusion and characterizations of the variables aptitude, quality of instruction, and opportunity to learn in the MSL as reviewed earlier are indeed foundational to much of what has transpired in mastery learning theory and practice.

Aptitude. Carroll's contention that one's aptitude for, say, mathematics, would govern the potential rate of one's learning of mathematics has been absolutely crucial to the mastery learning theme of prespecifying the degree of learning expected of each student at some mastery performance level and then, by addressing the instruction-oriented variables in the model, ensuring that the majority of students attains that level (cf. Block & Anderson, 1975; Bloom, 1968, 1978). Furthermore, this optimistic view of aptitude would seem to have encouraged among educators a more proactive/learning environment design orientation reflective of a developmental purpose of education as opposed to a more reactive/learner management approach reminiscent of a selective function of education.

Quality of instruction. Beyond the discipline-specific human characteristic labelled aptitude, Carroll's discussion of quality of instruction likewise has been of paramount importance to mastery learning development. The operative features inherent in this MSL variable include (a) the requisite alignment of instructional elements with the learner's needs and characteristics and (b) the identification of performance objectives, learning task sequencing, and feedback-corrective/ enrichment procedures as generic to any form of instruction worthy of being considered high quality. Embedded in this view of quality instruction is the foundation for the mastery learning emphasis on preconditions and operating procedures as means to maximize quality of instruction so as to minimize the student's time needed to learn--thereby accommodating the fixed amount of calendar time available to both students and teachers in the vast majority of instructional settings (again, cf.: Block , 1971, 1980; Block & Anderson, 1975; Bloom, 1968, 1978, 1980).

Opportunity. Opportunity to learn, or total amount of time allowed or made available for learning, is the third factor in Carroll's MSL that is basic to the impressive advancements in mastery learning over the past 20 years. Though at first glance this factor would seem to suggest the need for extensive latitude of actual time available for learning between entry and exit points for students in an instructional unit, such is not necessarily the case. Even in those settings where calendar time constraints impose definite starting and ending points for a

given instructional unit, mastery learning has accommodated the opportunity factor by virtue of its heavy emphasis on intermittent formative tests and learning prescriptions that, in effect, are tantamount to additional learning trials or opportunities within the same unit. Herein, also, lies the distinction acknowledged by Block and Burns (1976) between (a) an individually-based/student-paced approach to mastery learning (i.e., PSI) and (b) a group-based, teacher-paced strategy (i.e., LFM); in either case flexible opportunity for learning is being promoted beyond that typically found in non-mastery learning efforts.

Conclusion

Following an overview of the variables and operations inherent in Carroll's MSL as well as the assumptions and practices associated with Bloom's mastery learning, this paper has highlighted the strategic impact of Carroll's conceptualizations of aptitude, quality of instruction, and opportunity to learn on Bloom's optimism regarding the capability of students to learn and his diagnostic-prescriptive teaching regimen. The intent was to provide a 25-year retrospective view of the foundational role played by Carroll's MSL in advancing mastery learning efforts.

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